BREVIORA

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A NEW SPECIES OF *ATELOPUS* (ANURA:BUFONIDAE) FROM THE CLOUD FORESTS OF NORTHWESTERN ECUADOR

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ABSTRACT: *Atelopus cornei* is described from the Rio Faisanes in Pichincha Province, Ecuador. It appears to have an extremely restricted distribution and may be in danger of extinction as its habitat is altered by man. The new species is most closely to *Atelopus mindoensis*.

INTRODUCTION

The western slope of the Andes in northern Ecuador has a rich anuran fauna, much of which has been described only within the past decade. Until recently access to this area has been difficult due to its precipitous terrain and dense blanket of montane forest. Many species appear to have restricted distributions and it is not surprising that they were missed by early collectors. Within this forested zone, which extends up to at least 3000 m elevation, there are several distinct asemblages of frogs. Maximum species diversity apparently occurs between 1000 and 1600 m. Many of these species are very restricted in distribution; few are known from outside Ecuador. My field work in this region revealed the presence of an apparently new species of frog of the genus *Atelopus* that seems to exhibit an exceptionally restricted distribution even in comparison with other elements of this fauna. Despite extensive collecting efforts in the cloud forests of western Ecuador by myself and field parties from the Museum of Natural History of the University of Kansas, this new species remains known from only two localities within a few kilome-

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ters of each other. Given the rather precarious status of these habitats as human development encroaches, I take the opportunity here to describe this species before the populations become extinct.

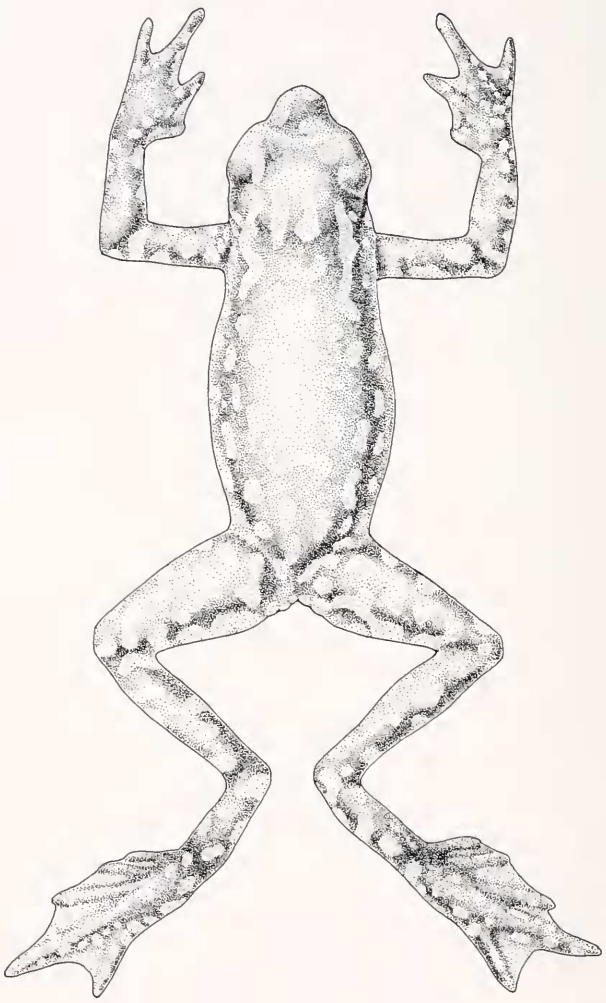

Figure 1. Dorsal view of holotype of *Atelopus coynei* (MCZ 91444).

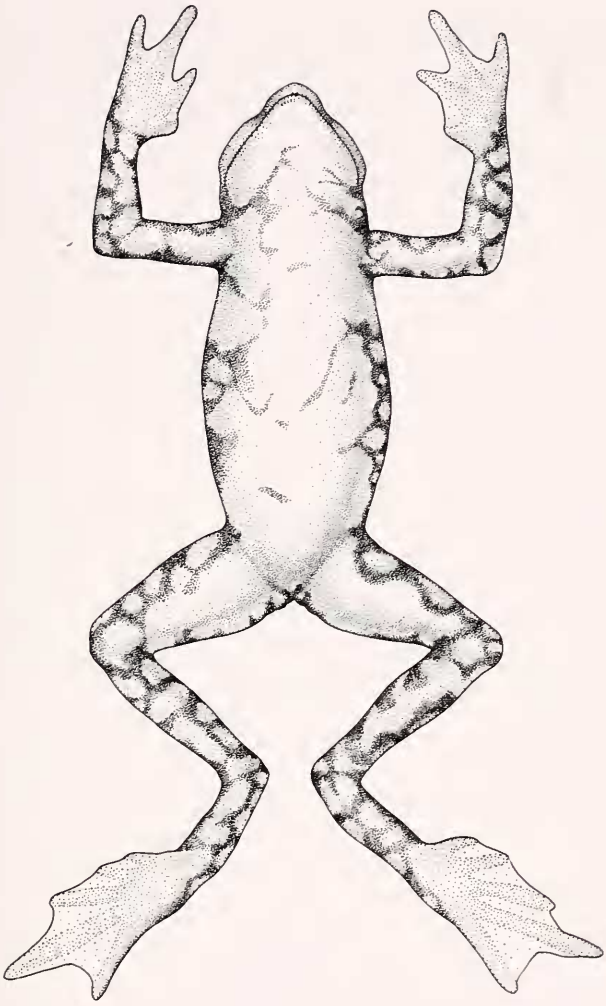

Figure 2. Ventral view of holotype of *Atelopus coynei* (MCZ 91444).

Atelopus coynei sp. nov.

Holotype: MCZ 91444, an adult male, one of a series collected on the banks of the Río Faisanes where it crosses Ecuador Highway 28 (the road from La Palma to Quito via Chiriboga), 14.4 km from the junction with Highway 30 (the Aloag to Santo Domingo de los

Colorados road) at La Palma, Pichincha Province, Ecuador, 1380 m, on 11 July 1976 by Godfrey Guynn, Kay Harker, Steven Kaal, Ken Miyata, David Paul, and Harrison Weed.

Paratypes. Topotypes: MCZ 91445-91449, 96775-96756, collected with the holotype; MCZ 91450, collected on 7 August 1976 by Jerry Coyne and Ken Miyata; MCZ 95411, collected on 8 January 1978 by Lauren Cardullo, Andrea Dion, Ken Miyata, Hugh Torbert, and Lisa Schwadron; MCZ 95676, collected on 30 April 1978 by Paul Greenfield and Ken Miyata; MCZ 96754, collected on 12 November 1977 by Ken Miyata; USNM 211171, collected on 17 February 1979 by Roy McDiarmid. From 4 km E Dos Rios, Pichincha Province, Ecuador, 1140 m: KU 164744, collected on 2 April 1975 by William Duellman.

Diagnosis. A small *Atelopus* (males to 23 mm, females to 32 mm) distinguished from all other known species by the following combination of characters: 1.) Hind limbs relatively long, the heels overlapping slightly when held parallel to femora at right angles to the body and reaching or just falling short of the orbit when adpressed. 2.) First finger almost entirely buried in a thick, rather fleshy webbing. 3.) Ventral pattern consisting of a sparse network of fine dark reticulations on a light opaque background.

Description. Head narrower than body, somewhat longer than wide. Snout projecting past tip of lower jaw, rounded from above. Projecting snout forming fairly sharp right angle above and in front of nostril in lateral profile. Nostrils opening laterally about 2/3 of way from anterior margin of orbit to tip of snout, directly above or slightly behind tip of lower jaw. From above, canthi diverging slightly from behind nostrils to a point just anterior of orbits where they diverge outward more abruptly. Canthus rostralis rounded with slight depression in loreal region. Interorbital space wider than upper eyelid. Tympanum hidden. Skin on head generally smooth with some very sparse and fine granulation.

Dorsum finely shagreened, dorsolateral folds absent. Venter and sides with numerous plate-like folds, smallest and most distinct on throat and neck, becoming larger and less distinct on sides and towards cloaca. Pair of narrow low ridges on dorsum in parotoid region.

Forearm slightly thicker than upper arm. Forefeet fleshy with thick webbing. First finger almost buried in fleshy webbing with only the tip free. Other fingers basally webbed with lateral fringes

extending past distal subarticular tubercles. Subarticular tubercles indistinct; palmar tubercle prominent, oval in shape. Males with cornified pad on inner margin of first finger.

Heels overlap slightly when tibiofibulae held parallel to femora at right angles to body. Adpressed heels reach to, or fall just short of, posterior margin of orbit. Tarsal fold absent. Hind feet fleshy with extensive thick webbing to tips of all toes except the fourth which is free distally. Subarticular tubercles indistinct; outer metatarsal tubercle small and rounded.

Measurements. Mean standard length for adult males is 22.6 mm, the single known adult female is 32.1 mm. The holotype is 22.4 mm. Table 1 summarizes the measurements and ratios used by Peters (1973) in his review of Ecuadorian *Atelopus.*

Color in life. The dorsum of males varies from green with dark brown reticulations to dark brown with green spots and blotches. In all specimens the dorsal green becomes turquoise blue laterally. The single adult female (MCZ 96754) was bright green with sparse dark brown dorsal reticulations and no trace of turquoise blue on the sides. The ventral surfaces of the males were opaque white, occasionally with a yellowish wash, with a sparse network of dark brown or black reticulations (Fig. 2). The female was a bright opaque yellow ventrally with dark brown reticulations and a reddish-orange wash on the palms and soles. This same reddish-orange wash on the palms and soles was seen on one male as well (MCZ 94511), but it was not as prominent as on the female. The iris varies from golden yellow to orange-copper.

Color in preservative. The parts of the dorsum which were green in life are pale lavender. The dark brown parts of the dorsal pattern remain brown, but are somewhat paler and have a reddish wash. The venter remains white in the males, but all traces of the yellow wash are lost. The female retains some of the yellow ventral color after 20 months in preservative. The ventral reticulations range from pale to medium brown.

Etymology. The specific epiphet is a patronym for Dr. Jerry Coyne, whose timely financial assistance helped stave off the wolves on several occasions and allowed me to complete the description.

Natural History

The Río Faisanes is a small mountain stream flowing through a narrow forested canyon where it crosses Ecuador Highway 28, 14.4

km from the village of La Palma on the road to Quito. The elevation of the stream where it crosses the road is given as 1380 m on a topographical map of the area prepared by the Instituto Geografico Militar of Ecuador in 1969 (Alluriquin quadrat, CT-NIII-A3, 3893-III). This falls into the "bosque muy humedo Pre Montano" ecological zone (Instituto Geografico Militar 1977), and the forest is characterized by a relatively low canopy height with an extremely heavy epiphyte growth. The Río Faisanes is rarely more than 5 m in width and few places are more than 0.5 m deep. The bottom consists of pea-sized gravel and the bed sometimes flows over or against large rocks. The water normally runs clear and in most places the canopy completely overhangs the water (see below). The other known locality where *cornei* has been collected (4 km E Dos Rios, 1140 m) is along the Río Orito and is located about 1.3 km NSW of the type locality. According to the topographical map, the elevation is 1280 m. The two small rivers flow into the Río El Tránsito, which then flows into the Río Pilaton a few kilometers to the SW.

All of the specimens taken on 11 July 1976 were collected along the banks of the Río Faisanes. Individuals were captured in the late afternoon while they were active on the rocky banks of the river during a light rain. At night additional specimens were collected sleeping on streamside vegetation, usually within 1 m of the ground and frequently on leaves overhanging the water. A total of 41 specimens was collected that day in approximately 18 person-hours of collecting along a 250 m stretch of the river. Most of these specimens were used for biochemical analysis of possible skin toxins by Harrison Weed and were not available for this description.

Subsequent visits to the Río Faisanes in July and August of 1976, May and November of 1977, January and April of 1978, and February of 1979 resulted in the collection of very few additional specimens. All of these later visits were made at night and hence no more active individuals were found. All of these specimens were sleeping on the tops of leaves within 1 m of the ground. These specimens were not taken along the Río Faisanes proper, but were found on the banks of a small tributary creek which crosses the road about 50 m SW of the Río Faisanes bridge.

Since the first visit to the type locality in July of 1976 the Río Faisanes seems to have become more silted as a result of small-scale logging operations and the canopy has been opened to a considerable degree in places. On the first visit the river was running clear despite the fact that it was high from the rains. On later visits the

Table 1. Measurements and ratios of *Atelopus coynei* (as in Peters 1973).

	Males (N=7)	*Female (N=1)*
Standard distance	22.6 mm	32.1 mm
Knee-knee	20.3	29.2
Tibofibula	10.6	15.5
Head width	6.6	8.7
Head length	7.8	10.5
Knee-knee standard distance	87.7	91.0
Tibiofibula standard distance	47.1	48.3
Head length standard distance	34.4	32.7
Head width head length	84.5	82.9
Tibiofibula head length	137.1	147.6
Tibiofibula knee-knee	52.5	53.1

water was often cloudy and turbid even though the level was low and there had been no recent rains. The scarcity of frogs after the first visit may be due partly to the increase in human activity along the stream which may have rendered it unsuitable for larval development. An increase in suspended silt in the water due to this human encroachment may cause the scraping of the algae off the surface of the rocks before the tadpoles can get to it.

Only a single female *coynei* has been found out of a total of 47 specimens (including the ones used for biochemical work). This is not necessarily indicative of a skewed sex ratio. All of the collections have been made along stream banks and McDiarmid (1971) has suggested that male *Atelopus* may spend considerably more time along the creeks than females. The large number of males taken on the first visit to the type locality is indicative of a breeding concentration and it is likely that the females had not yet arrived. Since then, individuals have been found in low concentrations and the bulk of the population may have dispersed into the forest. The apparent absence of *coynei* on recent visits may also be due in part to an absence of breeding concentrations.

Other anurans collected syntopically and synchronously with active *Atelopus coynei* include *Atelopus longirostris, Bufo chanchanensis, Eleutherodactylus achatinus, E. necerus,* and *Colostethus* sp.

Comparisons and Discussion

The relatively long hind limbs and the extensively webbed thumbs distingush *A. coynei* from all but a few species of *Atelopus*. Of these species, the hind limbs of *A. elegans, A. longibranchius, A. palmatus,*

and *A. rugulosus* are very long and the adpressed heel reaches beyond the anterior margin of the orbit, rather than just reaching or falling short of the posterior margin. In *A. cruciger* from Venezuela and *A. flavescens* from French Guiana the adpressed heels reach to near the posterior margin of the orbit, but they lack webbing between the second and third fingers and are larger than *A. coynei* (male *A. cruciger* to 29 mm, male *A. flavescens* to 32 mm).

Atelopus coynei most closely resembles *A. mindoensis*. The most striking difference between these two species is ventral pattern, with *A. mindoensis* lacking the reticulations which are characteristic of *A. coynei*. There are a number of other differences as well (Table 2) and there is little doubt that the taxa are distinct.

The description of a new species of *Atelopus* based on external morphology from two neighboring populations may seem unwise given the known degree of variation in such characters in some members of the genus (Peters 1973, Savage 1972). The close similarity of *A. coynei* to *A. mindoensis* may make it seem particularly suspect. Although *A. coynei* and *A. mindoensis* are almost certainly closely related, the differences outlined in Table 2 are consistent enough to warrant their recognition.

Although color pattern can be quite variable both within and between populations of some species of *Atelopus*, the ventral pattern of *A. coynei* is unique and allows the immediate recognition of

Table 2. *Atelopus coynei* and *mindoensis* compared

ATELOPUS COYNEI	*ATELOPUS MINDOENSIS*
Venter white to yellow with brown reticulations.	Venter reddish brown with yellow spots.
Ventral skin with numerous small scale-like folds anteriorly.	Ventral skin smooth or with small folds on throat.
Ventral skin completely opaque.	Ventral skin translucent to transparent.
Eggs not visible through skin in one gravid female known.	Eggs clearly visible through skin in gravid females.
No tubercles or enamelled pustules on back or sides.	Small tubercles and enamelled pustules on back and sides
Snout more rounded from above and coming to sharp angle from side.	Snout more pointed from above and coming to more rounded angle from side
No evidence of throat pouch in adult males.	Adult males with loose skin on throat.
Larger size; adult males average 22.6 mm, adult female 32.1 mm.	Smaller size; adult males average 18.7 mm (N=37), adult females 24.9 mm (N=22).

this species. I have examined the holdings of *Atelopus* in the MCZ collection and made a literature survey of all of the 40 presently recognized species (those listed by McDiarmid 1971 and subsequently described species; descriptions consulted in lieu of specimens include Bokermann 1962, Boulenger 1902, 1903, Cochran and Goin 1970, Donoso-Barros 1969, McDiarmid 1973, Noble 1921, Peters, 1973, Ruíz-Carranza and Hernandez-Camacho 1978, Savage 1972) and the only species that exhibit a reticulate ventral pattern are *A. chiriquiensis, A. longirostris, A. pachydermus, A. pulcher, A. tricolor,* and *A. varius.* In each of these species the reticulate pattern, when present (some species are variable in this character), is very bold and consists of thick lines mixed with blotches and spots. In contrast, the ventral reticulations of *A. coynei* are thin and sparsely distributed. Although the degree of this ventral marbling in *A. coynei* is variable, it is immediately recognizable in all of the specimens I have examined.

Although the 40 known species of *Atelopus* make it a relatively large assemblage of frogs, all of which are Neotropical, the species are distributed with remarkably little geographical overlap. Extensive sympatry between species of *Atelopus* is unusual, a situation which is in striking contrast to that seen in other Neotropical anuran genera of similar diversity. The rather specialized breeding requirements of *Atelopus* may somehow inhibit overlap. In areas where two species of *Atelopus* occur in sympatry they are usually of quite different habitus. To date, *A. coynei* has been collected with the larger and more gracile *A. longirostris* but has not been found with the similar *A. mindoensis*. Although *A. mindoensis* is known from elevations between 20 m and 2100 m, the lower records are from the drainage of the Río Cachabí in Esmeraldas Province. On the Río Toachi drainage in Pichincha Province *A. mindoensis* appears to be restricted to elevations above 1500 m and does not come into contact with either *A. coynei* or *A. longirostris*. Since *A. mindoensis* and *A. longirostris* do come into contact in the Río Guayllabamaba drainage just to the north of the Toachi, it appears that *A. coynei* may be limited to the relictual populations described here.

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